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DIVISION 02 - SITE CONSTRUCTION

SECTION 02755

PORTLAND CEMENT CONCRETE PAVING

06/04

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SECTION 02755

PORTLAND CEMENT CONCRETE PAVING
06/04

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers construction of portland-cement concrete paving placed over a subgrade as provided under Section 02315 EXCAVATION AND FILL. This section includes the following:

Construction, curing, and protection of paving

Disposal of excess and waste materials

Review the following sections for inclusion with this section:

Section 02715 LIMEROCK BASE COURSE

Section 02716 LIME SOIL STABILIZATION

This section must be coordinated with Section 03305 CAST-IN-PLACE CONCRETE (SHORT SECTION) to eliminate duplication, conflict, and ambiguity.

Drawings must include a section view through paving and base course, location and design of expansion, construction and contraction joints, reinforcing details, openings in pavement, and integral curbs.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

The publications listed below form a part of this section to the extent referenced:

ACI INTERNATIONAL (ACI)

ACI 211.1	(1997) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988) Cold Weather Concreting
ACI 325.9R	(1991) Guide for Construction of Concrete Pavements and Concrete Bases

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf
AASHTO T 103	(1991; R 2000) Soundness of Aggregates by Freezing and Thawing
AASHTO T 2	(2000) Sampling of Aggregates
AASHTO T 26	(1979; R 2000) Quality of Water to be Used in Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 184/A 184M	(2001) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(2002) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 307	(2003) Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 615/A 615M	(2004) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 1107	(2002) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
ASTM C 114	(2004) Standard Test Method for Chemical Analysis of Hydraulic Cement
ASTM C 131	(2003) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136	(2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2003) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	(2002ae1) Standard Specification for Portland Cement
ASTM C 171	(2003) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(1999) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 183	(2002) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C 192/C 192M	(2002) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2003) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2001) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2001) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 289	(2003) Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	(2003) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31	(2000e1) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2003) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 40	(1999) Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C 42/C 42M	(2003) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2004) Standard Specification for Chemical Admixtures for Concrete

ASTM C 78	(2002) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 88	(1999a) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94/C 94M	(2003a) Standard Specification for Ready-Mixed Concrete
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1752	(2004) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM F 568M	(2002) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1 MSP	(2001e27) Manual of Standard Practice
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U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-L-3150	(1986c) Lubricating Oil, Preservative, Medium
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1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Construction Equipment List shall be submitted in accordance with paragraph entitled, "Construction Equipment List," of this section.

Daily Activity Report shall be submitted in accordance with paragraph entitled, "Concrete Testing During Construction," of this section.

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

Reinforcing Steel
Bar Lists

Erection/Installation Drawings shall be submitted for the following items in accordance with paragraph entitled, "Drawings," of this section.

Reinforcing Steel
Bar Lists
Expansion and Construction Joint Details

SD-04 Samples

Samples for the following items shall be submitted:

Wire Mesh
Fabricated Bar Mats
Reinforcing Bars
Joint Dowel Bars
Hook Bolts
Load-Transfer Devices
Metal Joint Inserts
Joint Materials
Curing Materials
Coarse Aggregates
Fine Aggregates
Air-Entraining Admixtures
Set-Retarding Admixtures
Portland Cement

SD-05 Design Data

Mix designs (Contractor and job) shall be submitted in accordance with paragraph entitled, "Concrete Mix Design," of this section.

SD-06 Test Reports

Test Reports for the following items shall be submitted in accordance with the paragraph entitled, "Concrete Testing During Construction," of this section.

Concrete Slump
Air Content
Test Specimens
Beam
Drilled Cores
Daily Activity Report
Location of Placement
Quantity in Cubic Yards of Placement
Quantity in Square Yards of Placement
Quantity in Cubic Meter of Placement
Quantity in Square Meter of Placement
Start Time of Pourer Placement

SD-07 Certificates

Certificates for the following items shall be submitted in accordance with the applicable referenced standards and descriptions contained in this section:

- Wire Mesh
- Fabricated Bar Mats
- Reinforcing Bars
- Joint Dowel Bars
- Hook Bolts
- Load-Transfer Devices
- Metal Joint Inserts
- Joint Materials
- Curing Materials
- Form Materials
- Concrete Materials
- Concrete Mix Design

SD-08 Manufacturer's Instructions

Manufacturer's instructions for the following items shall be submitted in accordance with applicable paragraphs that each refer to in this section.

- Cold-Weather Curing
- Hot-Weather Curing
- Curing Methods
- Sawing Concrete Joints
- Joint Sealant

SD-11 Closeout Submittals

The following shall be submitted in accordance with paragraphs entitled, "Concrete Testing During Construction" and "Ready-Mixed Concrete," of this section.

- Ending Time of Placement
- Delivery Tickets

1.3 SOURCE OF SUPPLY

Source of supply for materials shall be approved at least 15 calendar days before use. Source of materials shall not be changed except by written authorization.

1.4 DELIVERY AND STORAGE OF REINFORCING STEEL

Reinforcing steel shall be delivered, handled, and stored in accordance with the CRSI 1 MSP.

Reinforcement shall be segregated as to type, size, and length and placed in orderly piles on blocking or racks.

Piles of reinforcement shall be barricaded and have warning signs in the day and warning lights at night.

1.5 MAINTENANCE OF TRAFFIC

Vehicular and pedestrian traffic shall be maintained. Contractor shall keep open an adequate traffic lane or shall provide for a detour route.

Detours over roads within Government property shall be as approved and shall be designated and marked with proper signs.

1.6 CONNECTIONS WITH OTHER ROADS

Connections with other roads and public entrances shall be kept in a condition for the safe passage of traffic. When directed, the Contractor shall apply stabilization or surfacing material, or both, to connections and entrances at no additional cost to the Government.

1.7 PROTECTION OF PERSONS AND PROPERTY

Pavement work shall be conducted in a manner that will ensure the safety of persons and property.

Structures, utilities, sidewalks, existing pavements, and other facilities immediately adjacent to new pavement work shall be protected against damage, including settlement, lateral movement, undermining, and washout.

1.8 CONSTRUCTION EQUIPMENT LIST

Construction Equipment List for all major equipment to be used for this particular work shall be submitted by the Contractor prior to work.

1.9 DRAWINGS

Fabrication Drawings shall be submitted showing size and spacing for Reinforcing Steel and Bar Lists with reference to the contract design.

Erection/Installation Drawings shall be submitted including the size and spacing for Reinforcing Steel, Bar Lists and Expansion and Construction Joint Details with reference to the contract design.

PART 2 PRODUCTS

2.1 REINFORCING MATERIALS

**NOTE: Where plain concrete paving is specified,
delete paragraphs entitled, "Wire Mesh" and
"Fabricated Bar Mats."**

2.1.1 General

Reinforcing materials shall be clean, straight, and shop-fabricated to the indicated dimensions.

2.1.2 Wire Mesh

Mesh shall be welded, plain, cold-drawn steel wire fabric conforming to ASTM A 185.

2.1.3 Fabricated Bar Mats

Mats shall be welded or clip-assembled steel bars, size as indicated, and shall conform to ASTM A 184/A 184M. Bars used in fabrication of mats shall be Grade 60 deformed billet-steel bars conforming to ASTM A 615/A 615M.

2.1.4 Reinforcing Bars

Reinforcing bars and tie bars shall be deformed billet-steel bars, Grade 60, conforming to ASTM A 615/A 615M.

2.1.5 Joint Dowel Bars

Dowel bars for load transfer, expansion joints, and transverse contraction joints in reinforced concrete slabs shall be plain billet steel bars, Grade 60, conforming to ASTM A 615/A 615M. Bars shall be cut true to length with ends square and free of burrs.

2.1.6 Metal Expansion Caps

Metal expansion caps shall be provided for one end of each dowel bar in expansion joints. Caps shall be closed on one end with minimum lengths of 3 inches 75 millimeter and shall be designed to allow a subsequent movement of at least 1 inch 25 millimeter of each bar.

2.1.7 Hook Bolts

Hook bolts shall be ASTM A 307, Grade A ASTM F 568M bolts, externally and internally threaded. Bolts shall be not less than 9/16-inch diameter M15.

Joint hook bolt assembly shall be designed to hold the coupling against the pavement form and in the designated position during placing and finishing the concrete and shall permit removal without damage to the concrete or hook bolt.

2.1.8 Metal Accessories

Reinforcing bar accessories, chairs, ties, slab bolsters, and spacers shall be cold-drawn, industrial-quality, basic wire corrugated or straight, clean, and free of rust, furnished in sizes and quantities to adequately support reinforcement.

2.1.9 Load-Transfer Devices

Load-transfer devices for supporting dowels at expansion and contraction joints shall be constructed to hold the dowels firmly in position parallel to the surface and centerline of the slab.

Construction of the devices shall conform to ACI 325.9R.

2.1.10 Metal Joint Inserts

Metal-joint inserts for contraction joints shall be formed of zinc-coated steel sheets conforming to ASTM A 123/A 123M, Type 1, Class e, lightly zinc coated for severe forming.

2.2 JOINT MATERIALS

2.2.1 Preformed Joint Fillers

Fillers shall be preformed, nonextruding, resilient fillers conforming to ASTM D 1752, thickness as indicated.

2.2.2 Wood-Joint Fillers

Wood-joint fillers for temporary joint filling shall be sound heart redwood as approved.

2.2.3 Elastic-Joint Sealant

Joint sealant shall be a hot-poured rubber-modified asphalt joint sealer conforming to ASTM D 1190.

2.3 CURING MATERIALS

NOTE: One or more of the following curing materials
may be required, the application depending on
climatic conditions at the time of curing.

2.3.1 Cotton Mats

Cotton mats shall consist of a filling material of cotton covered with unsized cloth tufted or stitched to maintain the shape and stability of the unit, as approved.

Burlap cloth shall be made from jute or kenaf, plain weave, weighing 10 ounces per square yard 340 gram per square meter, conforming to AASHTO M 182, Class 3.

2.3.2 Impervious Sheeting

Waterproof paper shall be fiber reinforced, non staining, white, two-ply kraft paper conforming to ASTM C 171.

Polyethylene sheeting shall be white polyethylene film, 4-mil (0.004 inch) 0.102 millimeter minimum thickness, with water-retention capability conforming to ASTM C 171.

2.3.3 Liquid Membrane-Forming Compounds

Liquid membrane-forming compounds shall be a spray-applied, white-pigmented compound conforming to ASTM C 309.

2.3.4 Water Curing

Curing water shall be clean and free of deleterious substances.

2.4 FORM MATERIALS

2.4.1 General

Forms shall be of sufficient strength to resist springing during placement of concrete and to remain in vertical and horizontal alignment until

removed.

Forms shall be free of distortion and defects and shall extend the full depth of the concrete. Defective forms shall be replaced with new or repaired forms at no additional cost to the Government.

2.4.2 Steel Forms

Forms and accessories shall be steel, conforming to ACI 325.9R.

Forms shall include spring-steel flexible forms for forming curves and corner forms, form spreaders, and fillers as required.

2.4.3 Wood Forms

Wood forms shall be 2-inch 50 millimeter nominal thick planks, surfaced four sides, straight, free of defects, clean, and well-oiled.

Wood forms shall have a nominal length of 10 feet 3 meter, with a minimum of three stakes per form at a maximum spacing of 4 feet 1220 millimeter. Corners, deep sections, and radius bends shall have additional stakes and braces as required.

Radius bends may be formed with 3/8-inch 10 millimeter boards laminated to the required thickness.

2.4.4 Form Coating

Form oil shall be a nonstaining clear compound that will not discolor or injure the concrete.

2.5 CONCRETE MATERIALS

2.5.1 Aggregates

Aggregates shall conform to ASTM C 33.

Fine Aggregates shall be natural or manufactured sand.

Coarse Aggregates shall be crushed stone or crushed gravel.

2.5.2 Air-Entraining Admixtures

Material shall be a liquid air-entraining admixture conforming to ASTM C 260.

2.5.3 Set-Retarding Admixtures

Set-retarding admixtures shall conform to ASTM C 494/C 494M.

2.5.4 Portland Cement

Portland cement shall conform to ASTM C 150, Type [_____].

2.5.5 Mixing Water

Mixing water shall be potable.

2.6 CONCRETE MIX DESIGN

Concrete shall be portland cement concrete with an air-entraining admixture, with a minimum modulus of rupture of [_____] pounds per square inch (psi) kilopascal at 28 calendar days, minimum cement content of [six 94-pound bags of cement per cubic yard] [335 kilogram of cement per cubic meter] [_____] , and a maximum slump of 4 inches 100 millimeter.

Proportions of the concrete-mix design shall be determined by tests conducted in accordance with the basic relations and procedures outlined in ACI 211.1, using at least three different water-cement ratios. Under no circumstances shall the maximum water-cement ratio nor the minimum cement content be changed outside the limits specified for the quality of concrete to be used in the work.

Concrete-mix design test specimens shall be made as specified.

PART 3 EXECUTION

3.1 CONCRETE SAMPLING AND TESTING

3.1.1 Concrete Testing and Inspection Service

Concrete testing and inspection service shall be provided by the Contractor. Testing service shall be approved and shall include sampling and testing of concrete materials proposed for use in the work and field-testing facilities for quality control during construction.

3.1.2 Tests for Proposed Concrete Materials

NOTE: Delete the paragraph heading and the following paragraph when the total amount of concrete paving is minor, and can be accomplished by hand placing, finishing, and curing.

Concrete materials proposed for use in the work shall be sampled and tested as follows:

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Fine and coarse aggregates	Sampling	AASHTO T 2	One for each test set as specified under "Concrete-Mix Design Testing"
	Sieve analysis	ASTM C 136	
	Organic impurities (fine aggregate)	ASTM C 40	
	Soundness: freeze and thaw	AASHTO T 103 or	
	Soundness: magnesium sulfate	ASTM C 88	Freeze-thaw tests mandatory when total amount of concrete exceeds

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
cubic meter			250 cubic yards 190
	Potential re-activity of aggregates	ASTM C 289	
	Resistance to abrasion of small size coarse aggregate	ASTM C 131	
Portland cement	Sampling hydraulic cement	ASTM C 183	As specified
	Chemical analysis	ASTM C 114	
Water	Quality of water	AASHTO T 26	Test when water quality is questionable.
Admixtures (air-entraining)	Air-entraining admixtures for concrete	ASTM C 260	Tests of air-entraining admixture shall be made with the cement and aggregates proposed for use in the work, in accordance with ASTM C 233.

3.1.3 Concrete Mix Design Testing

Proportional mix design of the concrete shall be tested for conformance, as specified. Test specimens shall include the air-entraining and set-retarder admixtures proposed for use in the work. Tests shall be as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Preparing concrete compression and flexure Test Specimens in the laboratory	ASTM C 192/C 192M	At least one set test specimens (10 specimens in set); additional set when material source changes
Flexural strength of concrete	ASTM C 78	Three at 7 calendar days; three at 28 calendar days

3.1.4 Concrete Testing During Construction

Concrete shall be tested for quality control during construction as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Sampling fresh concrete	ASTM C 172	(*) One for each flexure, slump, and air-content test
Making and curing concrete Test Specimens in the field	ASTM C 31	At least one set of test specimens (six per set) for each 100 cubic yards or 75 cubic meter or fraction thereof; one when the material source changes
Flexural strength of concrete (Beam with 3-point loading)	ASTM C 78	Each set: two at 7 calendar days, three at 28 calendar days, one spare
Concrete Slump	ASTM C 143/C 143M	One to supplement each set of test specimens, three daily or more often at the request of Contracting Officer
Air Content of freshly mixed concrete	ASTM C 231	One to supplement each set of test specimens. Additional tests if air content falls outside limits
Obtaining and testing drilled cores of concrete Drilled Cores of concrete	ASTM C 42/C 42M	One core for each 500 linear feet 150 meter core at intersections, a total of at least three cores

(*) Concrete samples for testing shall be taken from the point of placement and not from the point of manufacture or point of discharge from the mixer.

Slump and air content tests shall be made from the same batch from which strength tests are made. Results of the concrete slump and air content tests shall be submitted within 24 hours after placement, along with the Contractor's Daily Activity Report. The Contractor's Daily Activity Report will include the following: location of placement, Quantity in Cubic Yards of Placement Quantity in Square Yards of Placement Quantity in Cubic Meter of Placement Quantity in Square Meter of Placement, Start Time of Pourer Placement, Ending Time of Placement and Delivery Tickets Copy.

To conform to requirements of this specification, the average of the 28-day strength tests of a set of specimens as well as the average of any five consecutive 28-day strength tests of a set of specimens shall be equal to, or greater than, the specified strength, and not more than one test in 10 shall have an average value of less than 90 percent of the specified strength. Should the tests fall below the strength specified, immediate corrective action shall be taken as directed.

Core holes shall be refilled with Portland cement concrete bonded to the pavement with a two-component polysulfide epoxy binder.

3.1.5 Mixer Performance Tests

Mechanical details of the mixers and agitators shall be checked before use. Slump tests from individual samples at the beginning, midpoint, and end of the load shall be taken.

If the slump measurements vary by more than 2 inches 50 millimeter, use of the mixer or agitator shall be discontinued until the condition is corrected. Slump test shall be in accordance with ASTM C 143/C 143M

3.2 MEASUREMENT OF CONCRETE MATERIALS

Aggregates, cement, mixing water, and air-entraining admixtures shall be measured in accordance with ACI 325.9R. Measurements shall conform to the accuracy limits listed for each material.

Air-entraining measuring device shall be capable of ready adjustment to permit varying the quantity of admixture to be batched. Dispenser shall be interlocked with the batching and discharging operations of the water so that the batching and discharging of the admixture will be automatic. When use of truck mixers makes this requirement impractical, the air-entraining-admixture dispenser shall be interlocked with the sand batcher.

3.3 MIXING AND DELIVERY OF CONCRETE

Method and location of batching, mixing, and delivery of concrete shall be approved prior to the beginning of the work and shall conform to the following:

NOTE: A portable batching plant located on Government property would be advantageous if the size of the project or rigid control of the concrete product would warrant its use and if center policy would permit it. Select only one of the following paragraphs.

Concrete shall be batched, mixed, and delivered from a batching plant located on Government property.

Concrete shall be batched, mixed, and delivered from a batching plant located on Government property or shall be ready-mixed concrete from a ready-mix plant located off Government property.

Ready-mixed concrete shall be from a ready-mix plant located off Government property.

3.4 BATCHING PLANT ON GOVERNMENT PROPERTY

NOTE: Delete the paragraph heading and the following paragraphs if a batching plant on Government property is not permitted.

**The paragraph heading and paragraphs must remain if
a batching plant is permitted as a Contractor option.**

3.4.1 Batching Plant, Mixer, and Storage Facilities

An approved batching plant, batch mixer, and related concrete material-storage facilities may be located on Government property in the designated area. Batching equipment, scales for weighing aggregates and cement, and trucking equipment shall conform to ACI 325.9R and specified requirements.

Batch plant shall be provided with accurate recorders for registering the quantities of each material batched. Recorders shall be placed in a position convenient for observation and shall be housed in cabinets provided with locks. Recorders shall produce on visible tapes or charts a printed or autographic record of the weights of cement and aggregates as batched and after the batches are discharged. Weights or volumes of water as batched shall likewise be recorded if batched at the batching plant. Charts or tapes shall clearly indicate the types of material batched and the different types of mixes used. Charts or tapes shall show the time of day stamped or printed at intervals of not more than 15 minutes. Recorded charts or tapes shall become the property of the Government.

Batching plant shall include a device for automatically counting the total number of batches of concrete mixed and delivered to the work.

3.4.2 Cement For Batching Plant

Cement may be furnished in bulk or in bags marked with the manufacturer's name and brand. Cement shall be dry and free from lumps and caking when delivered. Bulk cement shall be delivered in weathertight carriers and unloaded into the storage facilities by means of weathertight conveyors or other suitable means that will protect the cement from exposure to moisture. Immediately upon receipt at the site of the work, bagged cement shall be stored in a dry, weathertight, properly ventilated structure. Different brands of cement shall be stored separately and shall not be intermixed.

Shipments of cement shall be checked for weight when delivered, and accurate scales and labor for checking the weight of bagged cement shall be furnished by the Contractor. Approximately 1 percent of each shipment shall be selected at random and checked for weight, except that additional weight checks shall be made to determine compliance with the specification when deficiencies in weight are found.

Cement salvaged by cleaning bags or from discarded bags of cement shall not be used in the work.

3.4.3 Concrete-Aggregate Storage

Aggregates shall be handled and stored to avoid breakage, segregation, or contamination by foreign materials. Bulldozers shall not be used to move or distribute aggregate in stockpiles.

3.4.4 Storage of Admixtures

Admixtures shall be stored and handled in a manner that will prevent

contamination or deterioration. Use of frozen or damaged admixtures will not be allowed.

3.4.5 Batch-Plant Concrete

Concrete shall be mixed in a stationary mixer, a truck mixer, or a paver mixer. Mixer shall be designed and maintained to ensure both a uniform mixture of materials and discharge of this mixture without segregation.

Mixers and mixing time for concrete shall conform to the requirements of ASTM C 94/C 94M, except as follows:

Use of nonagitating equipment will not be permitted.

When a truck mixer or agitator is used for transporting concrete, the concrete shall be delivered and discharge completed within 60 minutes or before the drum has turned 300 revolutions, whichever comes first. Discharge shall be completed no more than 20 minutes after the mixing water has been added. Mixing operation shall begin within 30 minutes after the cement has intermingled with the aggregates.

3.4.6 Transportation of Concrete

Transportation of concrete mixed completely in a stationary mixer from the mixer to the point of placement shall be by a closed-body truck agitator or in a truck mixer operating at agitator speed. Vehicles transporting concrete mixed partially or completely in stationary mixers and truck mixers used for complete concrete mixing shall be capable of delivering and discharging the concrete without segregation. Equipment shall be provided that is capable of transferring the concrete from the transporting vehicle and distributing the concrete without segregation into its final position. When necessary for proper control of the concrete, mixing of transit-mixed concrete will not be permitted until the truck mixer is at the site of the concrete placement. Concrete shall not be transported in open or in nonagitating equipment.

3.5 READY-MIXED CONCRETE

NOTE: Delete the paragraph heading and the following paragraph if a batching plant on Government property is a mandatory requirement for the project. Heading and paragraph must remain if the batching plant and "ready mix" are Contractor options or ready-mixed concrete is mandatory.

Ready-mixed concrete shall conform to the requirements of ASTM C 94/C 94M, with modifications in the referenced ASTM specification as follows:

Section 4, "Materials." Delete in its entirety. Materials shall be as specified.

Section 5, "Ordering Information." Delete and substitute the following:

At least 10 calendar days before delivery of the concrete, the Contractor shall furnish a statement giving the source and properties of the proposed concrete-mix materials and the proposed concrete-mix design strength tests for the class of concrete

specified. Changes in the source of materials or the concrete-mix proportions shall not be made without prior written authorization.

Proportions of the concrete mix design shall be determined by tests conducted in accordance with the basic relations and procedures outlined in ACI 211.1, using at least three different water-cement ratios. Under no circumstances shall the maximum water-cement ratio nor the minimum cement content be changed outside the limits specified for the class of concrete to be used in the work.

At least three flexure-test specimens for each age to be strength tested shall be made and cured in accordance with ASTM C 192/C 192M and tested for flexure strength at 7 calendar days and 28 calendar days in accordance with ASTM C 39/C 39M.

From the results of the flexure-strength tests, a curve shall be plotted showing the relationship between the water-cement ratio and compressive strength. Maximum permitted water-cement ratio shall be that value shown by the curve to produce the design-minimum laboratory flexure strength at 28 calendar days as specified for the class of concrete to be used in the work.

Section 6, "Tolerances in Slump." Delete subsections 6.1.1 and 6.1.2 and substitute the following: Slump shall be not more than the value specified.

Section 11.3, "Central-Mixing Concrete." Delete the reference to nonagitating equipment. Use of nonagitating equipment will not be permitted.

Section 11.7. Delete and substitute the following: When a truck mixer or agitator is used for mixing or delivery of concrete, no water from the truck water system or elsewhere shall be added after the initial introduction of the mixing water for the batch. Concrete shall be delivered to the site of the work and discharge completed within 1-1/2 hours, or before the drum has turned 300 revolutions, whichever comes first, after the introduction of cement to the aggregates, except that in hot weather when the temperature of the concrete is 85 degrees F 29 degrees C and above, the 1-1/2-hour mixing and delivery time shall be reduced to 45 minutes. When a truck mixer is used for the complete mixing of the concrete, the mixing operation shall begin within 30 minutes after the cement has been intermingled with the aggregates.

Section 16, "Batch Ticket Information." Add the following: With each load of concrete delivered to the site of the work, the ready-mixed concrete manufacturer shall furnish 2 Delivery Tickets. In addition to the requirements of Section 16.1, delivery tickets shall provide the following information:

Type and brand name of cement

Amount of cement per cubic yard meter of concrete

Maximum size of aggregate

Weights of fine and coarse aggregate

Amount and brand name of air-entraining admixture

Total water content expressed by water-cement ratio

Certification that all ingredients are as approved

Strength, frequency, and number of flexural strength tests shall be as specified.

Section 18. Delete in its entirety.

3.6 HOT- AND COLD-WEATHER MIXING

During hot-weather conditions, aggregates and mixing water shall be kept as cool as possible. Chilled water or chopped ice shall be used, provided the water equivalent of the ice is calculated in the total proportion of mixing water. Aggregates shall be cooled by sprinkling immediately before use. Cement with a temperature in excess of 80 degrees F 27 degrees C shall not be used.

Concrete delivered in cold weather shall have a temperature at the time of placing of not less than 60 degrees F 16 degrees C or more than 80 degrees F 27 degrees C. Aggregates and mixing water shall be heated and mixed uniformly in the mixer before cement is introduced and in accordance with ACI 306R.

3.7 FORM WORK

3.7.1 Setting Forms

Forms shall be set to the required line and grade and braced and staked to resist the pressure of concrete placement, and shall have uniform bearing throughout their entire lengths and widths.

Sufficient forms shall be provided to allow continuous progress of the work without the necessity of removing forms less than 12 hours after placing concrete.

Forms shall be cleaned and oiled with nonstaining mineral oil immediately before the concrete is placed.

Should the subgrade between forms become rutted or disturbed, it shall be reshaped and compacted to specified tolerances.

Before concrete is placed, the subgrade or base course between forms shall be made true with a subgrade planer.

3.7.2 Form Tolerance

After forms are set in place, their top surface shall be checked for grade; trueness shall be verified with a straightedge not less than 10-feet 3000 millimeter long. Top of the form shall vary not more than 1/8 inch in 10 feet 3 millimeter in 3000 millimeter, and the longitudinal axis of the vertical face shall vary not more than 1/4 inch in 10 feet 6 millimeter in 3000 millimeter.

3.7.3 Material and Installation

NOTE: Delete the paragraph heading and the following paragraphs if concrete does not require a

moisture-retention barrier against subgrade porosity.

[Subgrade cover shall be water-resistant barrier paper, uncreped and reinforced, or may be clear polyethylene sheeting, 0.004 inch 0.102 millimeter in thickness, conforming to ASTM C 171.

Base course, after being shaped and compacted, shall be covered with subgrade paper. Ends shall be lapped 12 inches 300 millimeter and sides shall be lapped 4 inches. 100 millimeter. Care shall be taken to keep the paper intact during the placing of concrete. Holes and tears shall be taped before proceeding with the work.]

3.8 PLACING CONCRETE

3.8.1 General

Concrete shall not be placed until the subgrade, base course, and forms have been approved for line and grade. Subgrade shall be moistened to provide a uniformly dampened condition at the time concrete is placed.

Retempered concrete or concrete which has partially hardened shall not be deposited.

Exposed, newly placed concrete shall be protected.

3.8.2 Cold-Weather Placing

Concrete shall be placed, protected, and cured in accordance with ACI 306R.

3.8.3 Hot-Weather Placing

Concrete shall be placed, protected, and cured in accordance with ACI 305R.

3.8.4 Mechanical Spreading of Concrete

NOTE: Delete the paragraph heading and the following paragraphs unless the project size warrants the use of mechanical equipment for spreading and consolidating concrete. Slip form equipment may be used if required.

Concrete shall be spread by a mechanical spreader as soon as it is deposited on the subgrade, in a manner to avoid segregation and with as little rehandling as possible. Concrete along the face of the forms and adjacent to transverse joints shall be consolidated by internal vibration. Vibrators shall not come in contact with a joint assembly, reinforcement, or side forms.

Depositing and spreading concrete shall be continuous, as far as possible, between transverse joints. In the event of an unavoidable interruption of the work continuing more than 1/2 hour, a construction joint shall be placed. Sections less than 15 feet 4.5 meter in length between transverse joints will not be permitted and, if constructed, shall be removed at the Contractor's expense.

Workmen with shoes coated with earth or foreign material shall be forbidden

to walk in the freshly placed concrete or on finished concrete.

When adjacent pavement lanes are poured in separate pours, mechanical equipment shall not be operated on the recently placed pavement until the pavement has obtained a modulus of rupture strength of at least [_____] psi [kilopascal] [Megapascal], as indicated by test specimens. If finishing equipment only is carried on the existing lane, paving may be permitted after that lane has attained a modulus of rupture strength of [_____] psi [kilopascal] [Megapascal].

3.8.5 Hand Spreading of the Concrete

NOTE: Include the paragraph heading and the following paragraphs if the project size is minor and could be accomplished with transit-mix equipment and hand spreading of concrete.

Hand spreading of concrete will be permitted only when necessary and shall be done with square-faced shovels; rakes or hoes shall not be used.

Except where reinforcing steel is indicated, concrete shall be placed and spread in one course, monolithic construction, and consolidated by internal vibration, spading, and tamping along the face of the forms and at joints to remove voids and honeycomb. Hand spreading shall be done with square-faced shovels; rakes or hoes shall not be used.

Depositing and spreading concrete shall be continuous, as far as possible, between transverse joints. In the event of an unavoidable interruption of the work continuing more than 1/2 hour, a construction joint shall be placed. Sections less than 15 feet 4.5 meter in length between transverse joints will not be permitted and, if constructed, shall be removed at the Contractor's expense.

Finishing operations shall not begin until surface water has disappeared or is removed in an approved manner. Applying dry cement as an absorptive material will not be permitted.

Retempered concrete or concrete which has partially hardened shall not be deposited.

3.8.6 Placing Reinforcing Steel

When reinforcement is required, the concrete shall be placed in two operations. Initial pour shall be struck off to the entire width of the pour the required depth below the finished surface. Reinforcement shall be laid full length in final position without further manipulation. Top layer of concrete shall then be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced without additional cost to the Government.

Wire-mesh reinforcement shall be end-lapped one full mesh plus 2 inches 50 millimeter; edge laps shall be not less than 2 inches 50 millimeter. Laps shall be securely fastened at each edge and at two additional points along the top.

Reinforcement steel shall not be distributed along the road but shall be

placed in the concrete slab directly from the hauling equipment or from a bridge riding on the forms, except for irregular widths and where the use of hauling equipment is not practicable.

Longitudinal bars of fabricated bar mats shall have a lap of at least 30 diameters.

Width of the wire-reinforcement sheets or bar mats shall be 4-inches 100 millimeter less than the width of the slab. Allowable number of sheets between contraction joints or between contraction and expansion joints shall not exceed four.

Length of wire fabric or bar mats, when properly placed in the work, shall be such that the reinforcement will clear transverse joints by not less than 2 inches 50 millimeter nor more than 4 inches 100 millimeter.

3.9 JOINTS

3.9.1 General

Joints shall conform to ACI 325.9R and the specified requirements, except where indicated otherwise.

Joints shall be constructed true to line with the face perpendicular to the surface of the pavement. Longitudinal joints shall be constructed parallel to the centerline of the pavement, unless otherwise required, and shall vary not more than 1/2 inch 13 millimeter from the designated position. Transverse joints shall be constructed at right angles to the centerline of the pavement, and shall vary not more than 1/4 inch 6 millimeter from a true line. In no case shall the joint fall outside the center 3 inches 75 millimeter of the load-transfer device.

When the pavement is laid in partial-width slabs, or where existing pavements are being widened, transverse joints in the new slab shall be placed in line with similar joints in the existing pavement.

3.9.2 Longitudinal Joints

**NOTE: Include following paragraph for street paving
with longitudinal joints.**

Longitudinal joints shall be longitudinal-lane tie joints with tie bars or bulkhead construction with hook bolts.

Longitudinal-lane tie joints shall be weakened-plane joints formed by an approved metal-screed joint or a mechanically formed groove placed while the concrete is in a plastic state. A 3/8-inch 10 millimeter wide by 1/2-inch 13 millimeter deep sealing groove shall be provided to receive the joint sealant.

Longitudinal bulkhead construction joints with hook bolts shall be used in partial-width construction of concrete pavement and where a concrete curb or combination curb and gutter is constructed adjacent to the concrete pavement. A 3/8-inch 10 millimeter wide by 1/2-inch 13 millimeter deep sealing groove shall be provided to receive the joint sealant.

Longitudinal bulkhead construction joints with hook bolts and couplings

shall be attached to the forms or otherwise held in position during placing and finishing concrete to permit removal of pavement forms without damage to the concrete or hook-bolt assembly. Ends of couplings shall be protected from concrete, dirt, and damage. A rust-preventive oil conforming to MS MIL-L-3150 shall be applied into the ends of couplings. Ends shall be sealed with a rubber or plastic plug.

3.9.3 Transverse Contraction Joints

Transverse contraction joints in reinforced concrete pavement shall include a load-transfer unit and a weakened-plane joint formed in the slab by a formed-metal insert. Metal insert shall be designed to receive a poured joint sealant.

Dowel bars shall be accurately held in place to within 1/8 inch per foot 3 millimeter per 300 millimeter of length from the designated line and grade.

One end of each dowel bar shall be free to move in the slab. Two-thirds of the length of each dowel shall be coated with cutback asphalt. Cutback asphalt coating shall be dry and shall not be removed by handling and placing dowels in the joint.

Joints in plain concrete pavement shall consist of a weakened-plane joint formed in the slab by means of a metal insert. Metal insert shall be designed to receive a poured joint sealant.

Joints shall be spaced at a maximum of 30-foot 9.1 meter intervals for reinforced concrete pavement and at 20-foot 6.1 meter intervals for plain concrete pavement.

3.9.4 Construction Joints

Construction joints shall be placed at the end of pours and at places where paving operations are stopped for a period of more than 1/2 hour, except where such pours end at expansion joints.

Except where indicated otherwise, construction joints in both plain and reinforced pavement shall have a load-transfer device of the same type specified in ACI 325.9R.

Construction joints shall be constructed with a 3/8-inch 10 millimeter wide by 1/2-inch 13 millimeter deep sealing groove formed in the second pour by a wood or fiberboard temporary filler.

3.9.5 Expansion Joints

Expansion joints shall be spaced as indicated and shall include a load-transfer unit and a premolded joint filler, except that the premolded joint filler without the load-transfer unit shall be used for joints abutting concrete walks, curbs, structures, catch basins, manholes, inlets, and other fixed objects.

Load-transfer unit and dowels for expansion joints shall conform to ACI 325.9R, except where indicated otherwise.

3.9.6 Joint Fillers

Joint fillers for expansion joints shall extend the full width and depth of the joint. After installation, the top shall be not less than 1/2 inch 13 millimeter and no more than 1 inch 25 millimeter below the finished surface.

Joint fillers shall be furnished in lengths not less than the lane width being poured. Where more than one length is required, the sections shall be securely laced or clipped together.

Joint fillers shall be held in place during installation by an approved installing device. Top edge of the filler shall be protected with metal cap or an approved temporary filler while concrete is being placed.

3.9.7 Sawing Concrete Joints

Joints constructed by sawing shall be in accordance with ACI 325.9R.

Joints constructed with a concrete saw shall be cut as soon as concrete has hardened sufficiently to prevent edge damage. Width of the joint shall be approximately 1/8 inch 3 millimeter and shall be widened at top of groove to 3/8-inch 10 millimeter wide by 1/2-inch 13 millimeter deep. Depth of the groove cut shall be approximately one-fourth of the depth of the slab or to the depth indicated.

Sawing concrete shall be limited to widening joints to receive sealant and for joint repairs and minor jointing. Concrete sawing shall not be used to form contraction or weakened-plane joints.

3.10 FINISHING CONCRETE

3.10.1 General

Concrete finishing shall be performed by finishing machine or hand-finishing methods, as approved.

3.10.2 Striking Off and Consolidating Concrete

Immediately after depositing, the concrete shall be struck off and consolidated by an approved finishing machine or float to conform to the finished grade. While striking off, a uniform ridge of concrete shall be maintained ahead of the screed for its entire length. Sufficient mortar shall be worked to the surface to provide a dense, smooth finish. Excessive operation of the machine over a given area will not be permitted. Concrete shall be compacted by mechanical vibration or by approved hand methods for the full width of the slab and adjacent to joints to prevent voids and segregation from occurring against joint material, load-transfer devices, and joint-assembly units.

Equipment that cannot produce the required compaction and surface finish will be considered unsatisfactory. Contractor shall then furnish alternate equipment and methods that shall produce satisfactory pavement at no additional cost to the Government.

3.10.3 Floating Concrete

After the concrete has been struck off and consolidated, the surface shall be smoothed by means of a mechanical float or by a suspended pan float. Where mechanical floating is not possible, hand methods may be used, as approved.

Mechanical float shall be adjusted so that the float will pass over each section of pavement at least twice and may make one or two additional trips if required to properly compact the concrete and to produce a uniform

surface texture. Excessive operation over an area will not be permitted.

3.10.4 Straightedging and Surface Correction

After floating has been completed but while the concrete is still plastic, the surface shall be tested for trueness with a 10-foot 3000 millimeter straightedge.

Straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. Operation shall be repeated until the surface of the concrete is free from irregularities and is in continuous contact with the bottom of the straightedge. Straightedge shall then be moved forward half its length, and the operation repeated.

Depressions in the surface shall be filled with freshly mixed concrete, struck off, consolidated, refinished, and retested.

3.10.5 Final Finish

As soon as excess moisture or sheen has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric not less than 5 feet 1525 millimeter nor more than 10 feet 3000 millimeter in width over the full width of the pavement. Drag shall be pulled by a self-propelled foot bridge supported on the forms. Pavement shall be given a final finish by dragging the burlap over the full width of the pavement for a second time.

3.10.6 Edging at Forms and Joints

Edges of the slab, transverse joints, and construction joints shall be worked with an edging tool and rounded to the required radius.

Tool marks appearing on the surface of the slab shall be eliminated.

Joints shall be tested with a 10-foot 3000 millimeter straightedge before the concrete has set and correction shall be made to align joints with each other and with adjacent slabs.

3.10.7 Hand Finishing

Hand finishing concrete pavements will be permitted when approved and under the following conditions:

- To finish concrete already deposited in the event of a breakdown of mechanical equipment

- To finish narrow widths or irregular areas where operation of the mechanical equipment is impractical

- To finish minor amount of concrete paving where the use of mechanical equipment is impractical and hand finishing would be the normal procedure

Hand finishing concrete pavement shall conform to ACI 325.9R and shall be performed by approved methods and equipment.

When striking off and consolidating by hand methods, pours shall be limited

to single-lane widths or less, unless otherwise approved.

3.10.8 Surface Test

On the day following placing of the concrete, the pavement shall be tested with a 10-foot 3000 millimeter straightedge parallel with, and perpendicular to, the centerline as directed. Areas showing high spots exceeding 1/8 inch 3 millimeter but not exceeding 1/2 inch in 10 feet 13 millimeter in 3000 millimeter shall be marked and removed. Where the departure from the correct cross section exceeds 1/2 inch 13 millimeter, the pavement shall be removed and replaced at the expense of the Contractor.

Any section removed shall be not less than 10 feet 3000 millimeter in length and not less than the full width of the lane. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet 3000 millimeter in length shall also be removed and replaced.

3.10.9 Thickness Control

Pavement specimens shall be taken as specified. Diameter of the specimen shall be not less than 3 inches 75 millimeter. Location of core holes shall be as directed. Thickness of the pavement shall be not more than 1/2-inch 13 millimeter less than thickness indicated. Where the thickness is less than specified, the section shall be removed and replaced at the expense of the Contractor.

Test holes shall be refilled with portland cement concrete bonded to the concrete with polysulfide epoxy binder or nonshrink grout conforming to ASTM C 1107.

3.10.10 Removing Forms

Forms shall remain in place at least 12 hours after concrete has been placed, then shall be removed in a manner that will avoid damage to the pavement.

3.10.11 Honeycombed Or Defective Work

After the forms have been removed, the ends of joints shall be cleaned and minor honeycombed areas shall be pointed. Areas designated as "major honeycombed areas" will be considered defective work and shall be removed and replaced at the expense of the Contractor. An area or section so removed shall be not less than 10 feet 3000 millimeter in length and not less than the full width of the lane. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.

3.11 CURING

3.11.1 General

Freshly deposited concrete shall be protected from premature drying and maintained with minimum moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete.

3.11.2 Cold-Weather Curing

Concrete shall be protected and cured to prevent loss of moisture and to maintain the recommended concrete temperatures for cold-weather concreting in accordance with ACI 306R.

3.11.3 Hot-Weather Curing

Concrete shall be protected and cured for 7 calendar days during hot weather or during conditions of rapid drying of concrete in accordance with ACI 305R.

Contractor shall have facilities ready for curing operations. Exposed surfaces shall be protected from drying. Wherever practical, continuous water curing is preferable.

Windbreakers or sun-shading screens shall be provided when required by wind or drying conditions.

NOTE: Select one or more of the following curing methods. Wet curing is desirable except in winter curing. Impervious sheets, wetted burlap, cotton mats, straw, or hay is acceptable provided the surface is kept damp. Liquid membrane curing is economical but requires careful procedures when applied during temperature extremes and must not be permitted if the use of antispalling compounds is anticipated.

3.11.4 Curing Methods

Except during conditions of cold weather concreting, exposed concrete surfaces shall be wet cured for a minimum of 48 hours, beginning the process immediately after the finishing operations have been completed and as soon as concrete has hardened sufficiently to preclude surface damage. Concrete shall be cured by means of one or more of the methods listed:

Continuous water spray: Continuous water spray of exposed concrete surfaces shall be achieved by use of soil-soaker hoses or fog-spray nozzles to keep the surface moist but not flooded for the curing period.

Wetted burlap or cotton mats: Exposed concrete surfaces shall be covered with two or more layers of wetted burlap cloth or cotton mats. Material shall be saturated with water both night and day and held securely in place during the initial curing period.

Wetted straw or hay: Exposed concrete shall be covered with clean, loose straw or hay at the rate of 4 pounds per square yard 10 kilogram per square meter. Straw covering shall be wetted as soon as it is placed and kept saturated for the duration of the initial curing period.

If the covering becomes displaced during the curing period, it shall be replaced immediately.

Waste straw shall be disposed as specified.

3.11.5 Final Curing

Final curing of exposed concrete surfaces shall be achieved by continuing the method of initial wet curing for the duration of the curing period or by the use of one of the following:

Impervious sheets: Exposed concrete surfaces shall be covered with polyethylene sheets or kraft paper. Adjoining sheets shall be lapped at least 6 inches 150 millimeter and shall overlap ends at least 12 inches 300 millimeter. Joints shall be cemented or taped to form a continuous membrane. Sheets shall be in good condition; all perforations, tears, holes, or rips shall immediately be patched. Curing sheets shall be folded over exposed edges of concrete and secured in place.

A liquid membrane-forming compound shall be applied under constant pressure to exposed concrete surfaces in one or two uniform spray applications, as directed, at a rate of 150 square feet per gallon 3.7 square meter per liter of material by means of an approved pressure sprayer. Portable spray equipment shall be used for curing irregular-width pours or where the total amount of concrete is small.

At the time of use, the curing compound shall be in a mixed state. Spray equipment shall provide effective stirring of the compound during application.

Curing compound shall not be permitted to enter joints, nor shall it be allowed on surfaces to be subsequently joined with other concrete surfaces.

Spraying unit shall be equipped with a calibrated gage to ensure the quantity applied is as required. Unit shall provide a fine fog spray to the surface of the concrete.

An additional coat of compound shall be applied to all surfaces showing a discontinuity of coverage. Damage to any area covered with curing compound within the 7-day curing period shall be resprayed as specified.

Contractor shall provide alternate methods or equipment for the protection of the pavement in case of a breakdown of spray equipment.

Failure to provide complete and uniform coverage at the required rate will be cause for discontinuation of this curing method.

3.12 JOINT SEALING

3.12.1 Preparation

Temporary fillers shall be removed manually or with a saw cut. Joint opening and adjacent concrete surfaces shall be cleaned of extraneous matter.

Cleaning shall be accomplished by sand blasting or other approved methods. Residue from a sawed groove or the dust and sand present after sand blasting or cleaning shall be removed.

3.12.2 Joint Sealant

Longitudinal and transverse, expansion, and isolation joints shall be

sealed with the specified elastic joint sealant.

Joint sealant shall be handled, prepared, and placed in strict accordance with the manufacturer's printed or certified instructions. Special care shall be taken to preclude damage by overheating the sealant.

A copy of the manufacturer's printed or certified instructions shall be on the job for inspection and use before beginning the work.

Sealant shall not be placed when the air temperature is less than 50 degrees F 10 degrees C in the shade.

Each joint shall be cleaned of foreign matter, including membrane-curing compound, and the joint faces shall be clean and surface dry when the seal is applied.

Immediately after cleaning, joints shall be sealed in accordance with the manufacturer's written directions, completely filling the joint. Sealant shall be stirred during heating so that localized overheating does not occur.

Sealing compound spilled on the surface of the concrete outside the joint or adjacent surfaces shall be removed immediately.

Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to resist picking up of sealing compound. Sand or similar material shall not be used as a cover for the seal.

3.13 PREPARATION OF ANTISPALLING TREATMENT

Compound shall be applied to concrete no sooner than 28 calendar days after placement. Concrete surfaces shall be clean, dry, and free of oil, grime, and loose particles at the time of each application.

3.13.1 Precautions

Antispalling compound shall not be heated. Material shall be transported, handled, and applied with due regard to its low flash point. Contractor shall guard against open flame, smoking, sparks, and fire adjacent to open containers or applicators.

Antispalling compound shall be applied at air temperatures of 50 to 90 degrees F 10 to 32 degrees C. Compound shall not be applied at air temperatures lower than 50 degrees F 10 degrees C.

3.13.2 Application

Material shall be applied in accordance with the manufacturer's printed or certified instructions.

Two sprayed-on coats of compound shall be applied. First coat shall be applied at a rate of 35 to 40 square yards per gallon 7.5 to 9 square meter per liter; second coat at 55 to 60 square yards per gallon 12 to 13.5 square meter per liter. Time shall be allowed for complete drying between coats.

Equipment shall be clean before use to avoid discoloration of concrete. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.14 DEFECTIVE PAVEMENT

3.14.1 Repairs and Replacement of Pavement Slabs

Broken or defective slabs shall be replaced or repaired at no additional cost to the Government.

Nonreinforced concrete pavement slabs that contain the following defects shall be removed and replaced:

Pavement slabs with multiple cracks through the full depth of the slab separating the slab into three or more parts between contraction joints

Pavement slabs with one or more cracks through the pavement extending diagonally across more than one-third of the slab, in either a transverse or longitudinal direction. Pavement slabs containing a single diagonal crack intersecting the transverse and longitudinal joints within one-third of the width and length of the slab from the corner shall be repaired by removing and replacing the smaller portion of the slab.

Random cracks penetrating the full depth of the pavement shall be grooved and sealed with the specific joint sealant. Sealing groove shall be approximately 1/2-inch 13 millimeter wide and 3/4-inch 19 millimeter deep.

Random cracks that are tight and do not penetrate the full depth of the pavement shall be left undisturbed.

When necessary, the depth of crack penetration shall be determined by inspection of test cores, not less than 4 inches 100 millimeter in diameter, drilled by the Contractor at his expense, at locations directed. Core holes shall be refilled with portland cement concrete bonded to the pavement with polysulfide epoxy binder or with nonshrink grout conforming to ASTM C 1107.

When a transverse random crack terminates in or crosses a transverse contraction joint, the uncracked portion of the joint shall be filled with epoxy resin mortar or grout and the crack routed and sealed with the specified joint sealant. When a transverse random crack approximately parallels the planned contraction joint and is within 25 percent of the slab length from a contraction joint in nonreinforced pavement, the crack shall be routed and sealed and the joint filled with a bonded grout. When a transverse random crack is more than 25 percent of a slab length from the nearest contraction joint in nonreinforced pavement, both the joint and the crack shall be sealed with the specified joint sealant.

3.14.2 Pavement Protection and Opening to Traffic

Pavement shall be protected from damage until acceptance of the work. Traffic shall be excluded from the pavement until the concrete is at least 14 calendar days old or until specimen beams have reached a modulus of rupture of [_____] psi [kilopascal] [Megapascal], and as permitted.

To expedite construction, operation of paving mixers and batch hauling equipment will be permitted on new pavement after the pavement has been cured for at least 7 calendar days, the joints have been sealed or

protected, and specimen beams have reached a modulus of rupture of [_____] psi [kilopascal] [Megapascal].

Pavement carrying construction traffic or equipment shall be kept clean, and spillage of materials or concrete shall be immediately removed. Damage to pavement caused by equipment or traffic on the pavement before acceptance shall be corrected by repairing or replacing pavement at no additional cost to the Government.

3.15 CLEANUP AND WASTE DISPOSAL

Contractor shall clean up the site and dispose of waste materials and debris in accordance with Division 1.

After completion of the protection and curing period, insulating and curing materials shall be removed. Joints shall be sealed and excess materials removed from the site. Straw shall be removed from the site or distributed where directed.

Concrete surfaces shall be swept and washed free of stains, discolorations, and loose particles.

-- End of Section --